

Space Weather Technical Forecast

Issued on Friday, 14 January 2022 at 12:29 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales <https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales>

Space Weather Forecast Headline: G1/Minor Storm intervals likely from day 2 (15th).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity was Moderate in the last 24 hours. A moderate class flare was observed around 14/0200 UTC from just over the northeastern limb. This probably emitted by previous region AR2821, which is due back onto the Earth-side during the next few hours. There are currently eight active regions on the Earth-side, however no notable flares have been observed from these regions. 2924 remains the largest region, currently classified at Fao/beta, but has been inactive. The remaining regions are magnetically simple, small, weak and remain stable.

No Earth-directed CMEs have been observed.

Solar Wind / Geomagnetic Activity: Solar winds as observed by ACE and DSCOVR at L1 are slow-ambient, around 350 km/s. The density of the wind was near or slightly above average. Total interplanetary magnetic field (IMF) strength, Bt, was weak to moderate peaking at 10nT around 14/1000 UTC, with the Bz component varying weakly between -6 and +8 nT. Phi angle was predominantly negative (towards the Sun). Geomagnetic activity was Quiet (Kp 0-1).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) remained at Background levels throughout. High energy electron flux (greater than 2MeV) was at background levels, temporarily reaching moderate levels of 159 pfu at 14/0415 UTC. Electron fluence remained well below the Active threshold (1e8 integrated pfu), with 1.41e6 integrated pfu recorded at 14/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be Low or Moderate, and further C-class or M-class flares are anticipated to continue from the new active region appearing across the northeastern limb.

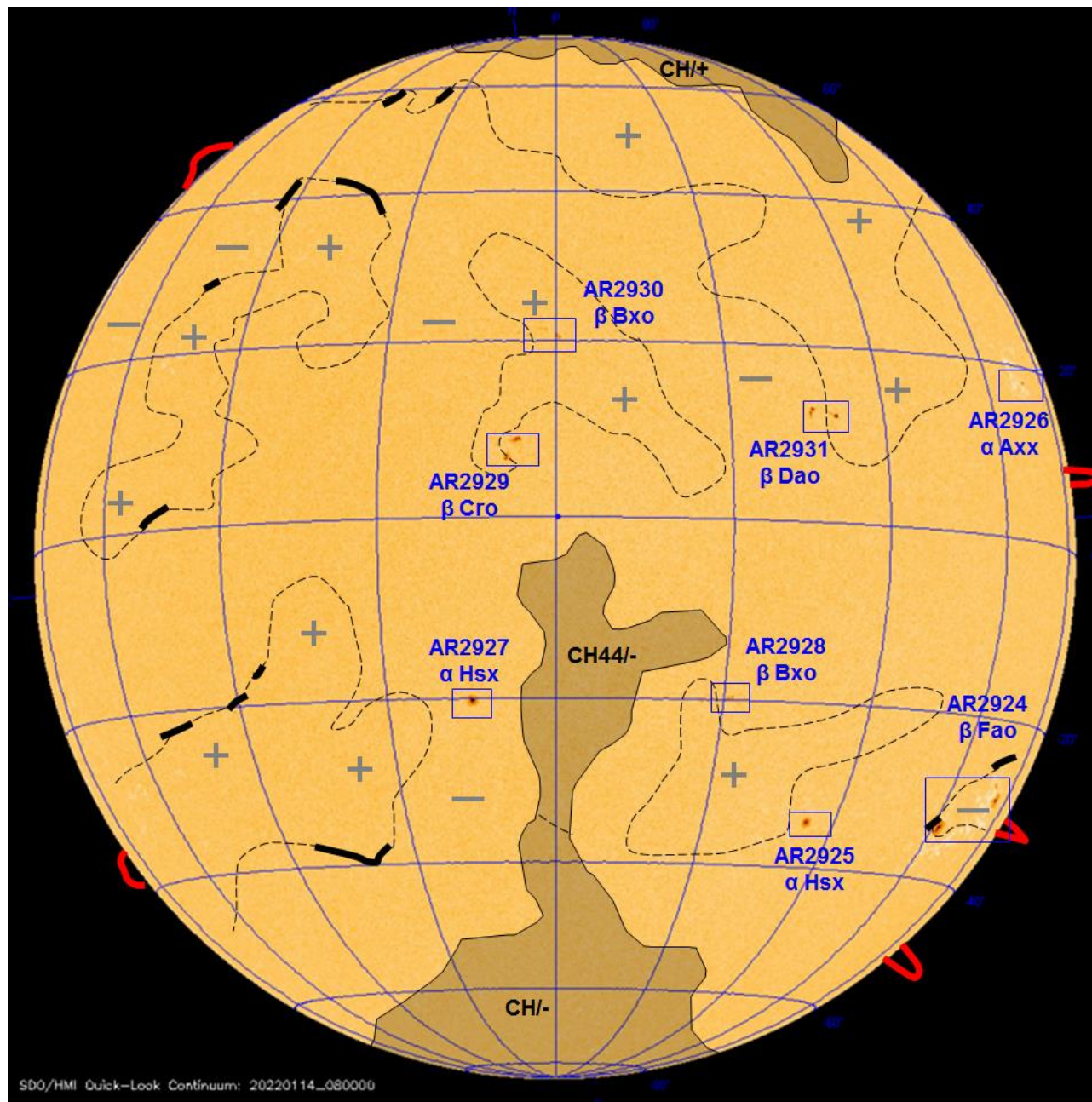
Solar Wind / Geomagnetic Activity: There are no Earth-directed CMEs. Slow-ambient solar winds are likely until the arrival of the high speed stream (HSS) related to coronal hole 44. This is most likely to occur tomorrow (15th), but with a slight chance of an early arrival later today. Quiet (Kp 0-2) geomagnetic activity is expected until this arrival, then becoming Active to G1/Minor Storm (Kp 4-5) as it occurs, with a slight chance of G2/Moderate Storms (Kp 6). Declining Quiet to Unsettled for days 3 and 4 (16th and 17th), with Active intervals and slight chance of G1/Minor Storms for day 3 (16th).

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux is forecast to remain at background levels. The high energy electron flux (greater than 2MeV) is expected to remain near background until after the arrival of the HSS related to coronal hole 44. The flux is then likely to become Moderate to High from day 3 (16th). The associated 24-hour

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electron fluence is expected to remain below the Active (1e8 integrated pfu) threshold for much of the period, but with a chance of reaching the Active threshold by the end of day 3 (16th), and then likely to reach the Active threshold during day 4 (17th).

Figure 1. Solar Analysis Valid 0800UTC, 14 January 2022.



Key: Filament ____, Prominence ____, Magnetic Field Line - - -, Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α - β - γ - δ and Zurich-McIntosh Axx etc.

Geomagnetic Storms:

There are no Earth-directed CMEs.

Slow-ambient solar winds on day 1 (14th) before the arrival of the HSS related to coronal hole 44, most likely early tomorrow (15th). Solar winds are forecast to reach 600-650 km/s and remain elevated through day 3 (16th). There is some uncertainty on the timing, with Enlil currently suggesting arrival through today, whilst STEREO A has seen both increased density followed by increased speed on the 12th. As STEREO A is currently observing conditions 2.7 days ahead of Earth, this corresponds to a HSS arrival late today or early tomorrow (14th/15th). Persistence would suggest arrival later on the 15th, however the coronal hole structure is markedly changed from the previous rotation; larger and more defined with its leading edge slightly further west. The bulk of the fast wind probably arriving later on day (15th).

Quiet (Kp 0-2) geomagnetic activity is expected until this arrival, then becoming Active to G1/Minor Storm (Kp 4-5) as it occurs, with a slight chance of G2/Moderate Storms (Kp 6).

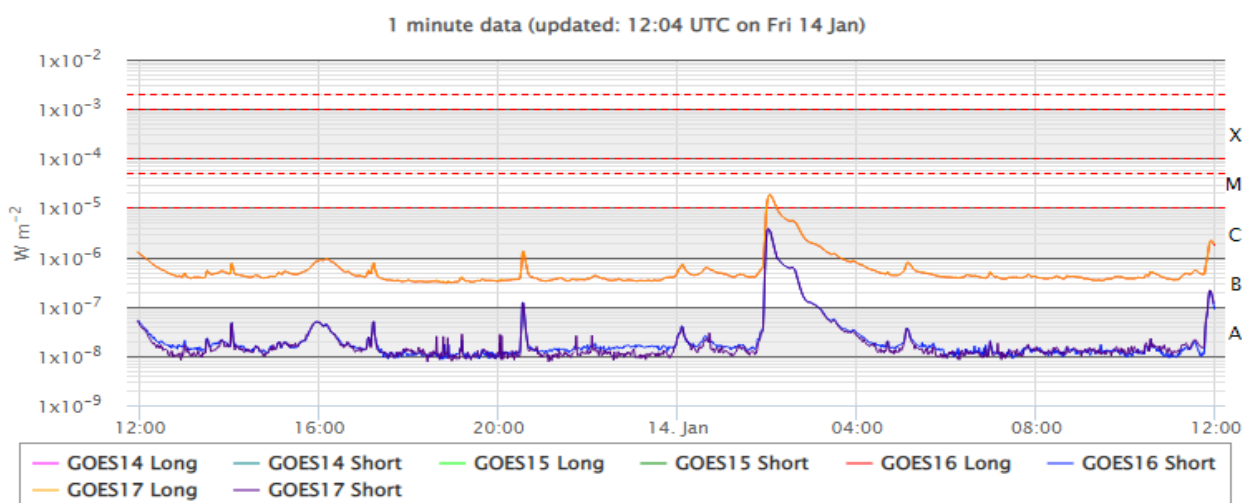
Declining Quiet to Unsettled for days 3 and 4 (16th and 17th), with Active intervals and slight chance of G1/Minor Storms for day 3 (16th).

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	10	60	40	10
Strong	G3	No	1	5	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil.

Figure 2: GOES X-ray flux plot with recent C-class and M-class flares from new AR appearing NE limb.



Radio Blackouts - X-Ray Flares:

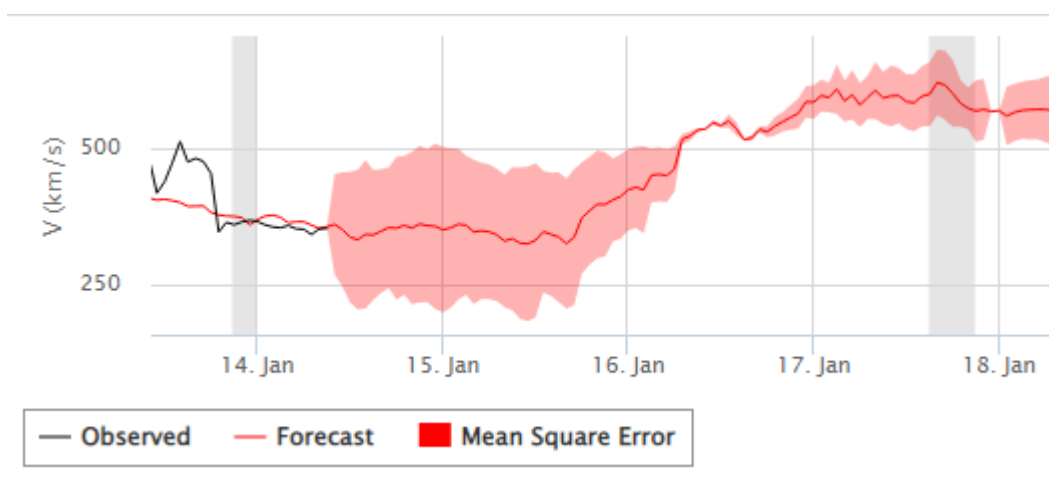
Solar Activity is currently Moderate with several of C-class flares observed recently and the M-class flare a few hours ago. There are currently eight active regions on the Earth-side, however no notable flares have been observed from these regions.

There are eight sunspot regions. AR2924 is inactive although the largest region. AR2925 and AR2927 continue as small mature regions. AR2926 remains small, weak and simple. AR2928 and AR2930 both Bxo/Beta and AR2929 Cro/Beta have been waxing and waning with no activity. AR2931 is relatively new and shows little chance with some weak trailer spots evident. Looping of a far-side region, perhaps ex-2821 (the source of far-sided flares in recent days) is emerging across the NE limb currently.

Over the next few hours the far-sided M-class flare source region, likely AR2921 from the previous rotation will rotate further onto the visible disc to allow an initial rudimentary analysis of its composition. A further large far-side sunspot (AR2918) is also signaled to rotate onto the disc by day 3 (16th). This brings an increased chance of M-class flares (R1/R2 Blackouts) and probabilities have been uplifted.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	40	40	30	30
Very Active	R3 to R5 X Class	No	5	10	5	3

Figure 3: Met Office Solar Winds Prediction Model (SWPM) showing HSS arriving during 15 Jan.



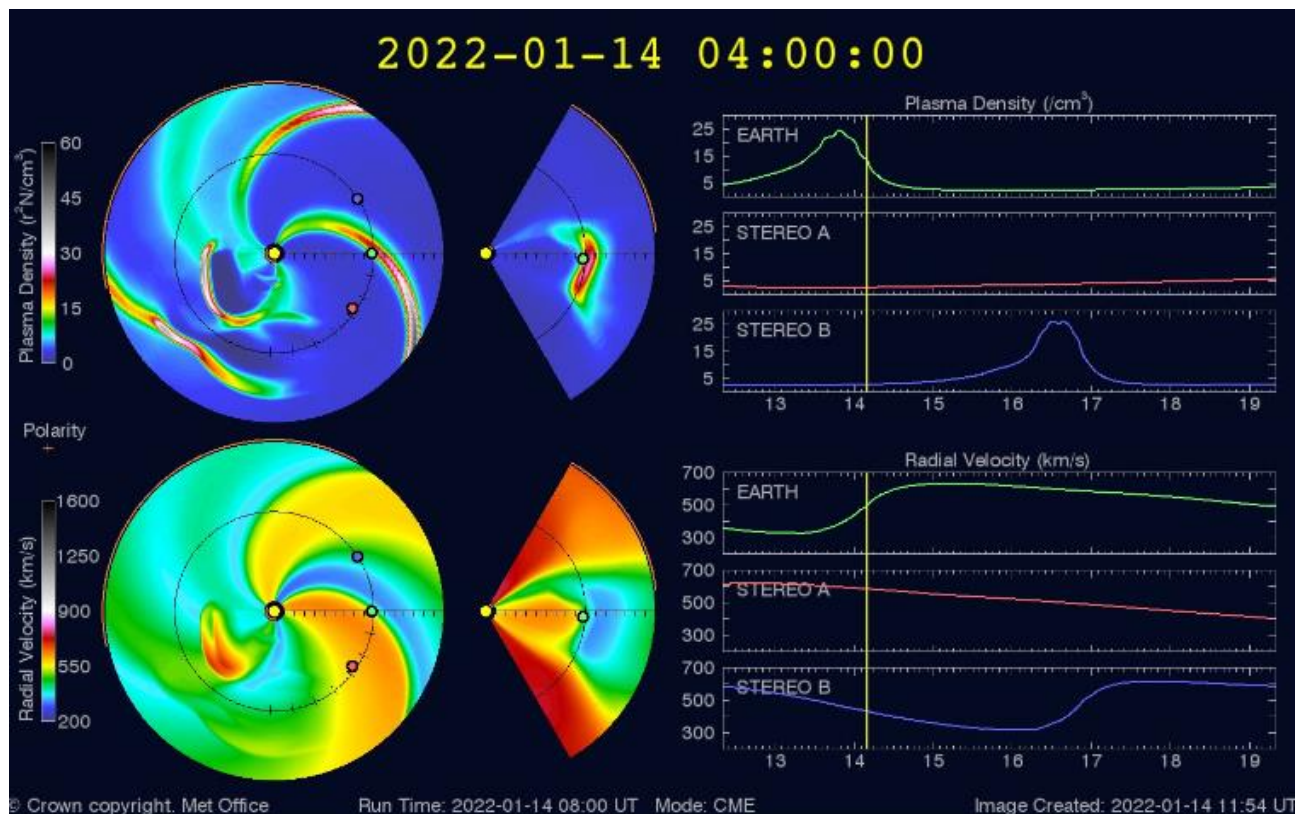
Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) as observed by GOES-16 is currently at background levels and will most likely persist at this level in the absence of solar activity.

Radiation Storms	Level ($\text{cm}^{-2} \text{sr}^{-1} \text{s}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq \text{S1}$	No	2	2	2	2
Very Active	$\geq \text{S3}^*$	No	1	1	1	1

* S3 $\geq 10 \text{ MeV} \geq 1000 \text{ pfu}$ and / or $\geq 50 \text{ MeV} \geq 10 \text{ pfu}$. (pfu = $\text{cm}^{-2} \text{sr}^{-1} \text{s}^{-1}$)

Figure 4: Met Office Enlil model with prediction of an arrival of HSS at Earth (in light green), which is too early.



High Energy Electrons Event ($\geq 2\text{MeV}$):

The high energy electron flux (greater than 2MeV) as observed by GOES-16 has been predominantly at background levels, just temporarily observed to reach moderate levels over recent days. Flux levels will remain below the alert level (1000 pfu) until after the arrival of the fast wind of CH44. This is forecast to occur tomorrow (15th) with a subsequent increase likely through day 3 (16th) but more especially through day 4 (17th) with alert levels likely to be reached.

The associated 24 hour electron fluence is expected to remain below the Active ($1\text{e}8$ integrated pfu) threshold for much of the period, but with a chance of reaching the Active threshold by the end of day 3 (16th), and then likely to reach the Active threshold during day 4 (17th). The Met Office REFM output is currently giving good guidance, showing the fluence gradually increasing whilst remaining below the Active threshold, during the first 3 days of the forecast period.

GEO Electron Environment	Level ($\text{cm}^{-2} \text{sr}^{-1} \text{day}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^8$	No	1	10	40	60
Very Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^9$	No	1	1	1	1

Figure 5: High energy electron flux at GEO and Met Office REFM output.

